Physically attractive faces attract us physically

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Abstract

When interacting with other humans, facial expressions provide valuable information for approach or avoid decisions. Here, we consider facial attractiveness as another important dimension upon which approach-avoidance behaviours may be based. In Experiments 1-3, we measured participants' responses to attractive and unattractive women's faces in an approach-avoidance paradigm in which there was no explicit instruction to evaluate facial attractiveness or any other stimulus attribute. Attractive faces were selected more often, a bias that may be sensitive to response outcomes and was reduced when the faces were inverted. Experiment 4 explored an entirely implicit measure of approach, with participants passively viewing single faces while standing on a force platform. We found greater lean towards attractive faces, with this pattern being most obvious in male participants. Taken together, these results demonstrate that attractiveness activates approach-avoidance tendencies, even in the absence of any task demand.

Keywords

Facial attractiveness; Approach-avoidance; Touchscreen; Force platform; Postural lean

1. Introduction

The most fundamental decision an animal can make about a stimulus is whether to approach or avoid it. Approach and avoidance can be facilitated by a physiological readiness, including autonomic changes (e.g., Lang, Bradley, Cuthbert, 1997), and most relevant here, the activation of motor responses. For example, reading a positively-valenced word like "gift" can lead to activation of muscles for approaching (Chen & Bargh, 1999).

Here, we investigate, for the first time, whether and how perceptions of facial attractiveness may be similarly coupled to activation of the motor system. Facial attractiveness is one of the most influential social variables and impacts a variety of social attributions and cognitions. However, it is not known whether this important social evaluation is insulated from, or directly activates, human motor systems. In fact, as we discuss below, there are reasons to expect that attractiveness might not behave as other variables investigated in approach-avoidance.

Approach-avoidance is sometimes described as arising from a *direct* association between stimuli and motor responses (Strack & Deutsch, 2004). Consistent with such an account, early research suggested that stimuli were tied to specific motor sequences (Chen & Bargh, 1999), so for example, if a stimulus were evaluated as negative, muscles for arm extension would be activated (to push the stimulus away), and arm flexion activated to approach positive stimuli (to bring an object closer). There are certainly cases in which a direct, reflexive response, such as an eye-blink to an aversive stimulus, is valuable (Lang, Bradley, Cuthbert, 1990).

Approach-avoidance has also been described as arising from *indirect* associations between stimuli and responses (e.g., Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010; Phaf, Mohr, Rotteveel, & Wicherts, 2014). According to these accounts, the response elicited by a stimulus is context dependent and goal mediated. Consistent with these accounts, there is clear disutility in many kinds of inflexible responses, encoded at the level of specific muscle contractions. For example, avoiding a spider might be better achieved by diametrically opposite muscle actions, depending on the specific situation: by pushing it away or by pulling back the hand. To the extent that approach-avoidance activation reflects an adaptive, functional mechanism, activated responses are therefore expected to produce useful effects, not hardwired motor sequences (Krieglmeyer et al., 2010).

In fact, it does appear that approach-avoidance responses are tied to response outcomes rather than specific motor sequences. For example, Bamford and Ward (2008; see also Markman & Brendl, 2005; van Dantzig, Pecher, & Zwaan, 2008) instructed participants to touch either pleasant or unpleasant pictures on a touchscreen. A separate manipulation varied whether the response outcome made the object increase or diminish in size. Bamford and Ward found that participants were faster when the response outcome increased rather than decreased the size of pleasant objects, and decreased rather than increased the size of unpleasant ones, even though the motor response was identical in all cases.

Although it is accepted that the affective quality of a stimulus (i.e., positive or negative) must necessarily be evaluated to generate an approach-avoidance response, there is ongoing debate about whether approach-avoidance behaviour is triggered automatically (e.g., Krieglmeyer, De Houwer, & Deutsch, 2013). Perhaps the most cited example of automatic affective evaluation (Chen & Bargh, 1999) has proven difficult to replicate (Rotteveel et al., 2015). An important meta-analysis by Phaf et al. (2014) found that while approach-avoidance effect sizes were robust when observers were explicitly instructed to evaluate the affective quality of an attended stimulus, average effect sizes were otherwise no different from zero. For example, Lavender and Hommel (2007) found approach-avoidance when participants were explicitly instructed to evaluate stimulus affect, but not when making spatial orientation judgements of the same stimuli. Therefore, when evaluating whether a stimulus generates approach-avoidance, it is useful to also test whether explicit instruction to affectively evaluate the stimulus is necessary.

Approach-avoidance has been generally assessed with non-social stimuli, such as valenced words and scenes (Phaf et al., 2014). The only class of social stimuli used repeatedly are emotional expressions, usually happy and angry faces. Goal-sensitive approach responses are activated after evaluation of happy expressions (e.g., Bamford & Ward, 2008), while responses to angry faces depend on observer interpretation of the response effect (Krieglmeyer & Deutsch, 2013). It therefore seems clear that evaluation of dynamic facial cues can lead to goal-sensitive motor activation.

This brings us to whether and how attractiveness might be related to approach-avoidance. We are not aware of previous studies investigating attractiveness and activation of approach-avoid responses. This is surprising, given that there are few social variables more influential than facial attractiveness. Attractiveness influences everything from mate choice (van Straaten, Engels, Finkenauer, & Holland, 2009) to lifelong earnings (Scholz & Sicinski, 2015). The effects of attractiveness on social attributions are well-known – most notably, the attractiveness halo, in which observers label attractive people with a variety of socially desirable characteristics (Eagly, Ashmore, Makhijani, & Longo, 1991). In laboratory studies, attractiveness readily influences behaviours other than ratings. Experiments using key-press tasks (alternating key presses to shorten or lengthen display time) found that more attractive faces were more rewarding to look at, resulting in participants being willing to work harder to keep these images onscreen (e.g., Aharon et al., 2001; Hahn, Fisher, DeBruine, & Jones, 2016). Similarly, facial attractiveness affects eye gaze, with viewers looking longer at more attractive faces during free viewing (Leder, Mitrovic, & Goller, 2016; Mitrovic, Goller, Tinio, & Leder, 2018). Further, when presented outside foveal vision and as irrelevant to the task itself, attractive faces were also better able to capture attention (Sui & Liu, 2009). Recent work by Faust and colleagues (2019) looked at effects of task-irrelevant faces on behaviour and argued that eye-movements are drawn towards extremes of attractiveness (both attractive and unattractive), while attractive faces seem to better capture covert attention over unattractive ones. Attractiveness, therefore, clearly exerts an effect on observers but it is not at all clear whether this influence includes activation of approach and avoid responses following stimulus evaluation.

We might initially expect that attractiveness should produce similar approach-avoidance as facial expression, but there are important differences between facial expression and attractiveness. Approach-avoidance biases relating to facial expressions are consistent with the value of expressions as communicative signals, reflecting current states of the signaller. These signals have evolved at least in part to guide the actions of observers (Darwin, 1872). By contrast, facial attractiveness is a stable trait variable, and by itself provides little information about appropriate social action. A bias to approach attractive faces and avoid unattractive ones is not necessarily an adaptive design feature, in the same way that avoiding venomous bugs, or approaching happy people, would be. In these experiments, we therefore assess the nature of approach-avoidance tendencies relating to attractiveness, their relationship to spontaneous evaluation, and their functional value, or goal-sensitivity.

2. Experiment 1 - Approach-avoidance and facial attractiveness

In our first experiment, we measure bias to approach attractive faces. Participants were instructed only to choose one of two simultaneously presented faces onscreen (one more consensually attractive). We could therefore measure a bias to respond towards the more attractive face, even in the absence of an explicit instruction to evaluate the stimuli based on affect or attractiveness. We also included a between-participants manipulation of Response Outcome, such that the touched image would either increase in size (approach) or decrease (avoid). This manipulation allowed us to assess whether responses to attractiveness might be goal-directed to produce approach rather than avoidance effects.

2.1. Method

2.1.1. Participants

Seventy-five university students (45 women; age *M* = 22.05 years, *SD* = 6.26 years) participated in exchange for course credits. The data from two additional participants were excluded due to technical issues.

Consideration of previous studies examining how response outcomes affected performance in approach-avoidance tasks indicated that we would need between 30 (Seibt, Neumann, Nussinson, & Strack, 2008) and 37 (Bamford & Ward, 2008) participants per condition to achieve 0.80 power to detect an effect of Response Outcome. We therefore aimed for a sample of approximately 35 participants per condition with the proviso that we had comparable numbers of men and women.

Participants provided written informed consent before taking part, and were given both written and verbal debriefings at the end of the experiment. The University of British Columbia's Department of Psychology ethics committee approved this experiment, along with Experiments 2 and 3, which were carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki.

2.1.2. Stimuli

Stimuli consisted of 100 images of White female faces. We chose to use only female faces as previous research has shown a more consistent perception of attractiveness in comparison with male faces (e.g., DeBruine, Jones, Smith, & Little, 2010). Images were downloaded from an online database (www.facity.com), which contained around two thousand high quality photographs of faces, taken front-on and with neutral expressions, hair pulled back, minimal make-up, and little or no jewellery. We started by selecting a set of 200 images that had closed mouths, with no visible teeth, and no jewellery. Women in the photographs were all aged approximately 18-30 (year of birth was available in the majority of cases). Images were already cropped below the hairline, and we additionally cropped them just below the chin, and close to the sides of the faces, using Adobe Photoshop CS software.

We then asked 22 students at Bangor University (9 females; age $M = 26.05$, $SD = 4.37$) to rate each of the 200 images for attractiveness on a scale from 1 (very unattractive) to 7 (very attractive). Participants were encouraged to use the full range of the scale. Images were presented individually onscreen (image size approximately 9.5 x 10.5 cm) using custom MATLAB software, in a random order for each rater, and responses were made using the mouse. There was high interrater agreement, with a Cronbach's α of .92. The mean rating for each photograph was calculated, with the 50 images rated most ($M = 4.46$, $SD = 0.44$) and least attractive ($M = 2.20$, $SD = 0.27$) providing the 100 images used in the main experiment.

Finally, we submitted the experimental images to two online algorithms in order to confirm that the 50 most and 50 least attractive images did not differ in facial expression. The first (Microsoft Azure Cognitive Services Face API) measured the proportions of eight different expressions (anger, contempt, disgust, fear, happiness, neutral, sadness, surprise) that were present in the faces. No images displayed any amounts of disgust or fear, and surprise was only detected in one face (at a level of 1%). For the remaining five expressions, we found no differences between the two sets of images, all $t(98) < 1.47$, all $p > .146$, all Cohen's $d < 0.29$. As expected, both the most ($M = 99.6\%$) and least attractive ($M = 98.8\%$) faces displayed predominantly neutral expressions. The second algorithm (Face++) simply reported the amount of smiling detected in the faces, and again, no difference was found, $t(98) = 1.55$, $p = .124$, Cohen's $d = 0.31$.

2.1.3. Procedure

At the beginning of the experiment, participants were told that they would see two face images on the screen and were instructed to select one of them with a finger touch. Because we were interested in the responses people are predisposed to make following the presentation of social stimuli, we did not further instruct participants on which face to select. In particular, there was no instruction to select the more attractive face. Any preference for responding towards attractive faces therefore indicates a response bias evoked by these stimuli.

Participants were assigned to one of two Response Outcome conditions (Increase or Decrease) which defined what happened after the participant's response. In the 'Increase' condition, when a response was made, the selected face got larger while the unselected one got smaller (see Fig. 1; based on Bamford & Ward, 2008). In contrast, for the 'Decrease' condition, the selected face got smaller while the unselected one got larger. These size changes occurred immediately after the participant's response. Details of the size changes were as follows: images started at 21.5 x 24.1 cm. They either increased in size to 30.4 x 34.1 cm or decreased in size to 15.3 x 17.1 cm.

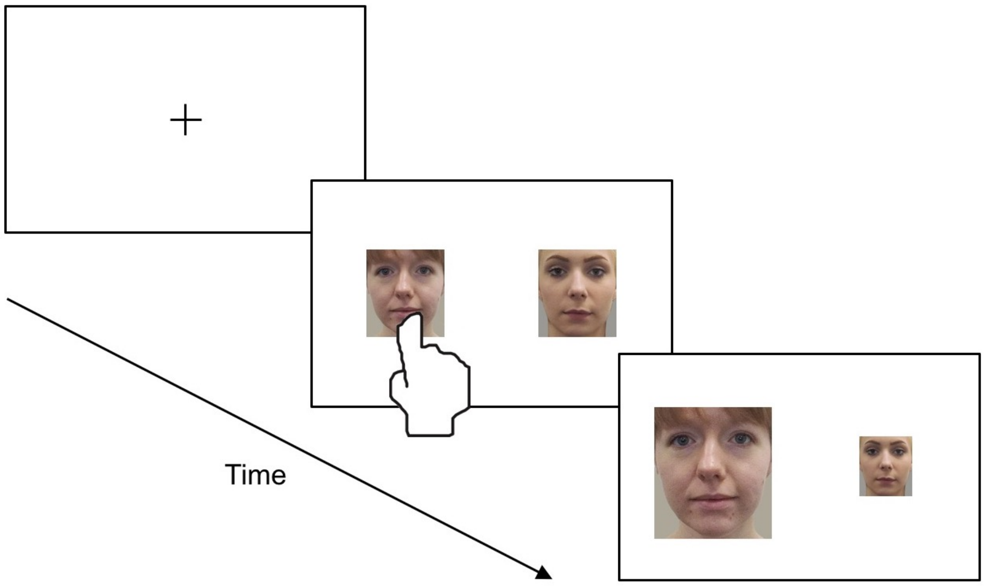

Fig. 1. Illustration depicting the task where participants touched an image. In this example of the Increase condition, the selected image gets larger and the unselected one smaller. The two identities shown here did not appear in the experiment but have given permission for their images to be reproduced.

For each participant, the 50 low and 50 high attractive faces were randomly paired to create 50 different trials. On each trial, participants were presented with a central fixation cross for 1 s, followed by two face images. Participants selected one of the faces using a finger press to the touchscreen. This caused both faces to change in size, with the nature of the changes dictated by the Response Outcome condition. The resized images remained onscreen for a duration of 4-6 s (randomly chosen on each trial) before being replaced by a fixation cross denoting the start of the next trial.

Half of the trials presented the low attractive face on the left of the screen, with the trial order randomised for each participant. The experiment was displayed on an HP LD4200tm 42-inch widescreen LCD interactive digital signage display (93 x 52 cm), controlled by a Dell Precision T3500 desktop computer. Viewing distance was not fixed.

The assignment of participants to the two Response Outcome conditions (Increase/Decrease) was based upon when they signed up to take part, with data collected for 'Increase' ($n = 37$) then 'Decrease' ($n = 38$).

2.2. Results

For each participant, we calculated the proportion of trials in which the more attractive face of the pair was selected. We further analysed responses using a 2 (Response Outcome: Increase, Decrease) x 2 (Participant Sex: Male, Female) between-subjects analysis of variance (ANOVA).

In all conditions, participants chose the attractive face more often than would be predicted by random selection (50%), all ts > 4.98, ps < .001, Cohen's ds > 1.04. The ubiquitous bias to select attractive faces in the absence of an explicit instruction to evaluate the stimuli is consistent with direct activation of an approach response. By itself, this result is consistent with previous demonstrations showing that attractive faces are better competitors for attention than unattractive ones. However, this bias to respond towards attractive faces was moderated by the Response Outcome (see Fig. 2). We found a significant main effect of Response Outcome, $F(1, 71) = 4.54$, $p = .037$, $\eta^2_p = .060$, such that the more attractive face was selected more frequently for the Increase ($M = 0.83$) compared to the Decrease outcome ($M = 0.75$). That is, our results are not explained solely by a competition for attention (for example, as shown by Faust et al., 2019) but must also include the effect of responses to promote approach or avoidance: unattractive faces were more likely to capture behaviour when the effect of the response was to "push away" the unattractive face and "approach" the attractive one. There was no significant effect of Participant Sex, $F(1, 71) = 2.47$, $p = .121$, $\eta^2_p = .034$, and no Response Outcome x Participant Sex interaction, $F(1, 71) = 2.37$, $p = .128$,

η^2_p = .032. In summary, participants were biased to respond towards the more attractive of two faces, despite being given no instruction to do so. Further, this bias towards attractiveness had characteristics of both direct responses (as evidenced by the large bias for attractiveness regardless of Response Outcome) and goal-mediation (as evidenced by the Response Outcome effect).

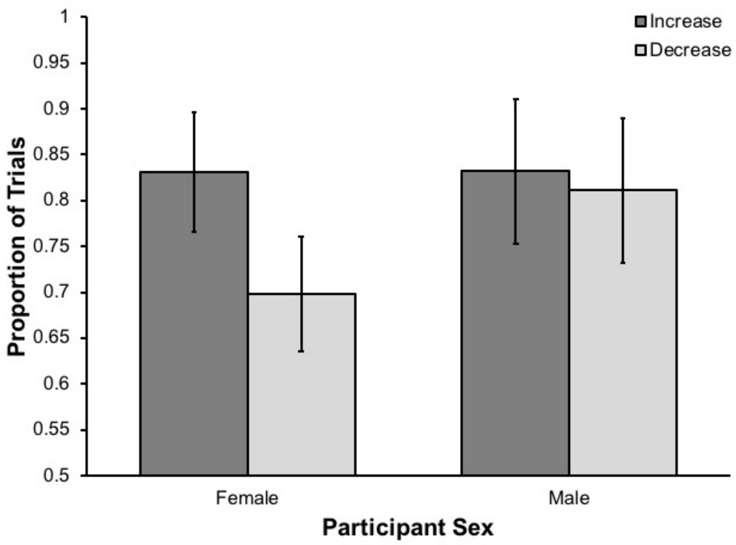

Fig. 2. The results of Experiment 1, illustrating the proportion of trials in which the more attractive face of the pair was selected. Error bars represent 95% confidence intervals.

3. Experiment 2 - Functional bias in approach

In Experiment 1, we found an approach bias for the attractive face regardless of response consequences, as well as evidence that the bias was sensitive to the response outcome. In this experiment, we tested whether approach to attractive faces might show some further sensitivity to response outcomes by changing the response modality. Rather than reaching out and directly touching the selected image, participants used a mouse to make their selection. In this case, mouse movements do little to bring the body or hand closer to the attractive face. Yet in terms of the response outcome, the mouse movement produces the same result as touching the stimulus onscreen. If response outcomes are important for approach-avoidance to attractiveness, the bias to select attractive faces should remain much the same as in Experiment 1.

3.1. Method

3.1.1. Participants

Seventy-eight university students (48 women; age M = 20.24 years, SD = 1.91 years) participated in exchange for course credits. The data from one additional participant were excluded due to technical issues. Recruitment was based on the sample size used in Experiment 1.

Participants provided written informed consent before taking part, and were given both written and verbal debriefings at the end of the experiment.

3.1.2. Stimuli

The same stimuli as in Experiment 1 were used here.

3.1.3. Procedure

The procedure was identical to the one used in Experiment 1. The only difference was in the method of response – here, participants selected faces using a mouse click rather than a finger touch.

The assignment of participants to the two Response Outcome conditions (Increase/Decrease) was based upon when they signed up to take part, with data collected for 'Increase' (n = 40) then 'Decrease' (n = 38).

3.2. Results

For each participant, we calculated the proportion of trials in which the more attractive face of the pair was selected, using a 2 (Response Outcome: Increase, Decrease) x 2 (Participant Sex: Male, Female) between-subjects ANOVA.

As in Experiment 1, in all conditions, participants chose the attractive face more often than would be predicted by random selection (50%), all ts > 6.12, ps < .001, Cohen's ds > 1.28. Our ANOVA found no significant main effects of Response Outcome, $F(1, 74) = 0.78$, $p = .381$, $\eta^2_p = .010$, or Participant Sex, $F(1, 74) = 1.45$, $p = .232$, $\eta^2_p = .019$. However, there was a significant Response Outcome x Participant Sex interaction, $F(1, 74) = 5.46$, $p = .022$, $\eta^2_p = .069$ (see Fig. 3). We therefore considered the simple effects of Response Outcome at each level of Participant Sex. These simple effects were significant for women, $F(1, 74) = 6.73$, $p = .011$, $\eta^2_p = .083$, but not men, $F(1, 74) = 0.86$, $p = .357$, $\eta^2_p = .011$. For women only, the more attractive face was selected more frequently for the Increase ($M = 0.83$) compared to the Decrease outcome ($M = 0.73$).

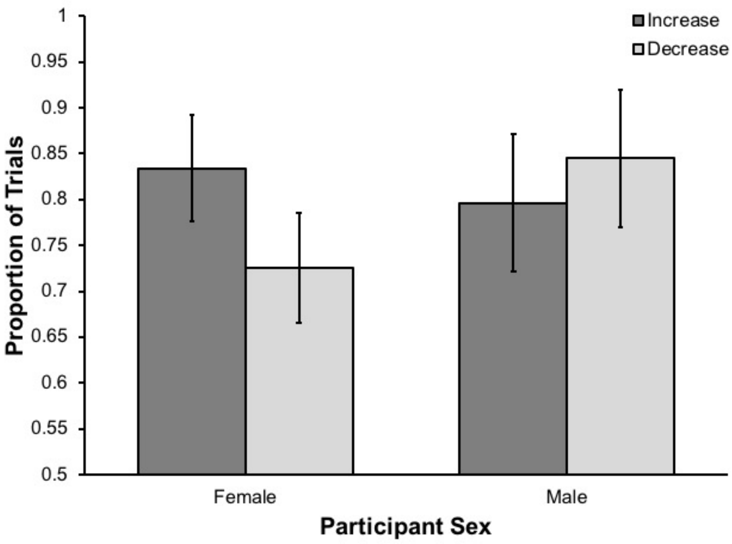

Fig. 3. The results of Experiment 2, illustrating the proportion of trials in which the more attractive face of the pair was selected. Error bars represent 95% confidence intervals.

Further, we were able to directly compare the results here with those of Experiment 1 in order to see whether response modality (touching with the finger or clicking with the mouse) affected choices. A 2 (Response Modality: Touch, Click) x 2 (Response Outcome: Increase, Decrease) x 2 (Participant Sex: Male, Female) between-subjects ANOVA found no significant main effect of Response Modality, $F(1, 145) = 0.09$, $p = .769$, $\eta^2_p = .001$, and no two- or three-way interactions between Response Modality and the other variables (all ps > .343, all $\eta^2_p < .006$). Again, the evidence supports the presence of a direct stimulus-response association that can influenced by an indirect goal-mediated pathway, irrespective of the response modality.

4. Experiment 3 - The effect of configural attractiveness

Experiments 1 and 2 showed similar approach tendencies for attractive faces. Here, we verify these effects were due to the configural effects of attractiveness and not irrelevant characteristics like brightness or other global features. Inversion reduces the effects of facial attractiveness (Olson & Marshuetz, 2005). If our previous results were due to attractiveness, we should see significantly reduced approach bias in this experiment. However, if our effects were due to some simple physical characteristic confounded with attractiveness, we should see no change in approach to the attractive face stimuli.

4.1. Method

4.1.1. Participants

Ninety university students (60 women; age *M* = 20.53 years, *SD* = 2.53 years) participated in exchange for course credits. Recruitment was based on the sample sizes used in Experiments 1 and 2.

Participants provided written informed consent before taking part, and were given both written and verbal debriefings at the end of the experiment.

4.1.2. Stimuli

The same stimuli as in Experiments 1 and 2 were used here.

4.1.3. Procedure

The procedure was similar to the one used in Experiments 1 and 2. The main difference was in the orientation of the stimuli – here, participants were presented with inverted faces. In this experiment, we combined the response modalities investigated separately in Experiments

1 and 2, such that participants responded using either a finger touch or a mouse click. We limited the experiment to the conditions producing the most easily measured approach effects, so that the response outcome was always to Increase.

The assignment of participants to the two Response Modality conditions (Touch/Click) was based upon when they signed up to take part, with data collected for ‘Touch’ (n = 45) then ‘Click’ (n = 45).

4.2. Results

For each participant, we calculated the proportion of trials (out of 50) in which the attractive face of the pair was selected. We further analysed responses using a 2 (Response Modallity: Touch, Click) x 2 (Participant Sex: Male, Female) between-subjects ANOVA.

In all conditions, participants chose the attractive face more often than would be predicted by random selection (50%), all ts > 7.22, ps < .001, Cohen’s ds > 1.86. We found no significant main effects of Response Modality, $F(1, 86) = 0.05$, $p = .817$, $\eta^2_p = .001$, or Participant Sex, $F(1, 86) = 2.73$, $p = .102$, $\eta^2_p = .031$, and no significant Response Modality x Participant Sex interaction, $F(1, 86) = 0.00$, $p = .979$, $\eta^2_p = .000$ (see Fig. 4).

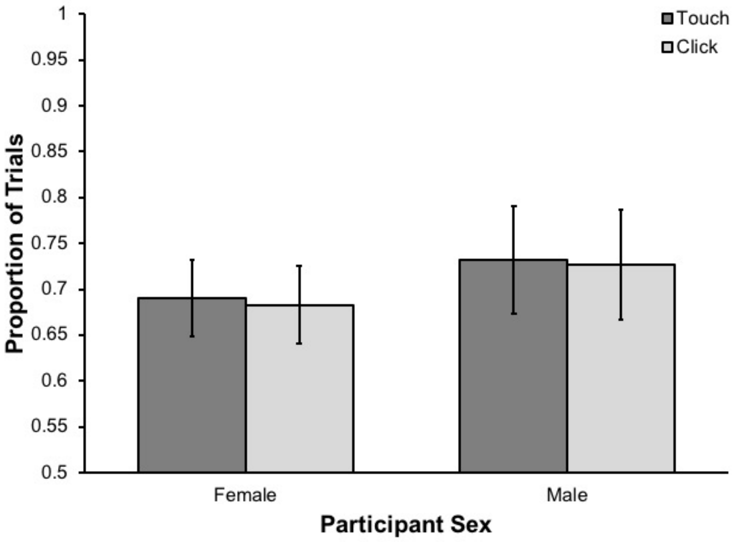

Fig. 4. The results of Experiment 3, illustrating the proportion of trials in which the more attractive face of the pair was selected. Error bars represent 95% confidence intervals.

The outcome of main interest was to directly compare the results here with those of Experiments 1 and 2, and to determine whether face orientation affected the bias towards attractiveness, which it did. A 2 (Orientation: Upright, Inverted) x 2 (Response Modality: Touch, Click) x 2 (Participant Sex: Male, Female) between-subjects ANOVA found a significant main effect of Orientation, $F(1, 159) = 35.21$, $p < .001$, $\eta^2_p = .181$, such that the more attractive face was selected more frequently for the Upright ($M = 0.82$) compared to the Inverted orientation ($M = 0.71$). No other main effects or interactions were significant (all *p*s > .117). The reduced bias found with inverted faces demonstrated that the attractiveness of the faces, rather than other global features of the images, was key to approach tendencies.

5. Experiment 4 - Approach bias to attractiveness when there is no task

In Experiments 1-3, we did not instruct participants about how to select faces. By definition, we were measuring a bias that did not require explicit instruction to evaluate facial attractiveness or affective quality, yet we still observed strong approach effects. However, these experiments still required participants to make some kind of response. If participants could observe the faces without any task requirement, would we still see an approach bias? To answer this question, our final experiment measures participant body position using a force platform, allowing us to assess whether they literally move their bodies closer to more attractive face images. If the attractive faces directly activate motor responses then evidence of an approach response should be observed despite the absence of any explicit task.

5.1. Method

5.1.1. Participants

One hundred and four undergraduate university students (66 women; age $M = 19.34$ years, $SD = 2.37$ years) volunteered to take part in this experiment in exchange for course credits. All participants had normal or corrected-to-normal vision. Data for 19 additional participants were discarded before analyses due to issues during balance board data collection (feeling unwell, current health problems that affected balance, and frequent fidgeting and talking), resulting in instability at baseline prior to stimulus presentation. Sample size was determined a priori based on previous research (100 participants – Brunyé et al., 2013; 50 participants – Roelofs, Hagenaars, & Stins, 2010), which inspired our experimental design, given that no previous experiments have investigated the association between attractiveness and lean.

Participants provided written informed consent before taking part and received both a verbal and written debriefing upon completion. The experiment's design and procedure were approved by the Trent University's ethics committee and conform to the Declaration of Helsinki.

5.1.2. Stimuli

The same 100 face images were used here as in Experiment 1.

5.1.3. Procedure

The experiment consisted of two parts. First, participants passively viewed facial images while standing on a Nintendo Wii Balance Board (WBB), which measures centre of pressure while the participant stands naturally. In the second part of the experiment, participants viewed the same faces again, while seated, and rated their attractiveness.

During passive viewing, participants stood on a WBB that collected centre of pressure data along two axes (towards/away from the screen, and side-to-side) at a rate of 16 Hz. The term 'balance board' may be somewhat misleading, as the board is a firm, solid-state, surface. No particular balancing task is required. Our analyses focused on changes in pressure with movement towards or away from the screen, which we will call "lean". Measures of lean produced by the WBB have previously shown adequate reliability and sensitivity in comparison with professional-grade force platforms (Bartlett, Bingham, & Ting, 2012; Bartlett, Ting, & Bingham, 2014; Clark et al., 2010). Custom MATLAB software was developed that enabled us to record lean and thus changes in body posture. The size of this shift is calculated from the change in weight distribution over the four (two left and two right) sensors of the WBB.

Participants were instructed to stand on the centre of the WBB and to adopt a comfortable, natural stance, either barefoot or wearing socks, with their arms hanging alongside their bodies and with their feet apart. Images were viewed on a 20” computer monitor at a distance of 60 cm in a dimly lit room, with the height of the monitor adjusted to match each participant’s eye level.

On each trial, a fixation cross appeared for 3 s in black on a white background, followed immediately by a face, which remained onscreen for 3 s. Images were shown at approximately 15 x 17 cm here (slightly larger than during the ratings task) to be more comparable with life-sized faces. Participants were instructed to stand still, remain relaxed, and to watch the sequence of images on the monitor. One hundred female faces were presented in a random order, with a short break provided half way through the sequence.

Upon completion of the viewing task, participants sat at a second 20” computer monitor and viewed all 100 faces again (image size approximately 9.5 x 10.5 cm), presented in a random order. (The overhead light in the testing room was switched on for this task.) On each trial, participants rated facial attractiveness using a 0 (very unattractive) to 9 (very attractive) scale. The task was self-paced, with images remaining onscreen until a response was given using the mouse. Viewing distance was not fixed.

5.2. Results

First, we recoded the raw data in terms of the dynamics of participant lean during the trial. Anterior-posterior centre of pressure data (towards/away from the screen) for each trial were referenced to a 500 ms pre-stimulus window (i.e., the last 500 ms of that image’s preceding fixation cross presentation). The 3 s presentation time was then divided into six time bins of 500 ms each, and average lean computed for each bin. Fig. 5 gives an overview of the data by showing the function relating attractiveness and lean, across time, for male and female participants. By the final time bin, men and women were tending to lean towards faces they find more attractive, and away from faces they find less attractive. This tendency is present from the start for men and grows over time; it seems to develop more gradually for women.

Statistical analyses were carried out using a linear mixed effects model (lme4 package – Bates, Maechler, Bolker, & Walker, 2015). For our model, we predicted each of the 62,400 measures of lean in our data set (104 participants x 100 faces x 6 time bins), using as fixed effects the factors of participant sex, the participant's attractiveness rating of the image being viewed, the time bin, and all two-way and three-way interactions of these factors. Quantitative variables were standardised to $M = 0$, $SD = 1$. Participant and image were both included as random factors, as were correlated random slopes by attractiveness for participants and for images. Models using more complex random effects structures were identified as singular (Barr, Levy, Scheepers, & Tily, 2013). For significance reports, degrees of freedom were estimated using Satterthwaite's method (lmerTest package – Kuznetsova, Brockhoff, & Christensen, 2017).

We found a significant main effect of Time, ß = -.022, SE = .004, $t(6193) = 5.39$, $p < .0001$, such that as time increased, there was increased posterior lean (i.e., away from the screen). However, there was also an Attractiveness x Time interaction, $\beta = .018$, SE = .004, $t(6193) = 4.37$, $p < .0001$, so that with increasing time, observers leaned closer to the screen for faces they personally rated more attractive. There was also a three-way interaction of Attractiveness x Time x Participant Sex, $\beta = .017$, SE = .004, $t(6193) = 2.66$, $p = .008$, such that men showed a larger effect of attractiveness with time than women. These effects of attractiveness are illustrated in Fig. 5.

There was also a marginal interaction of Participant Sex x Time, β = .008, *SE* = .004, *t*(6193) = 2.02, *p* = .04, such that men showed overall less posterior lean with time than women; and a Participant Sex x Attractiveness interaction, β = .022, *SE* = .0107, *t*(6193) = 2.06, *p* = .04, such that men showed more lean than women towards attractive faces, across all time bins.

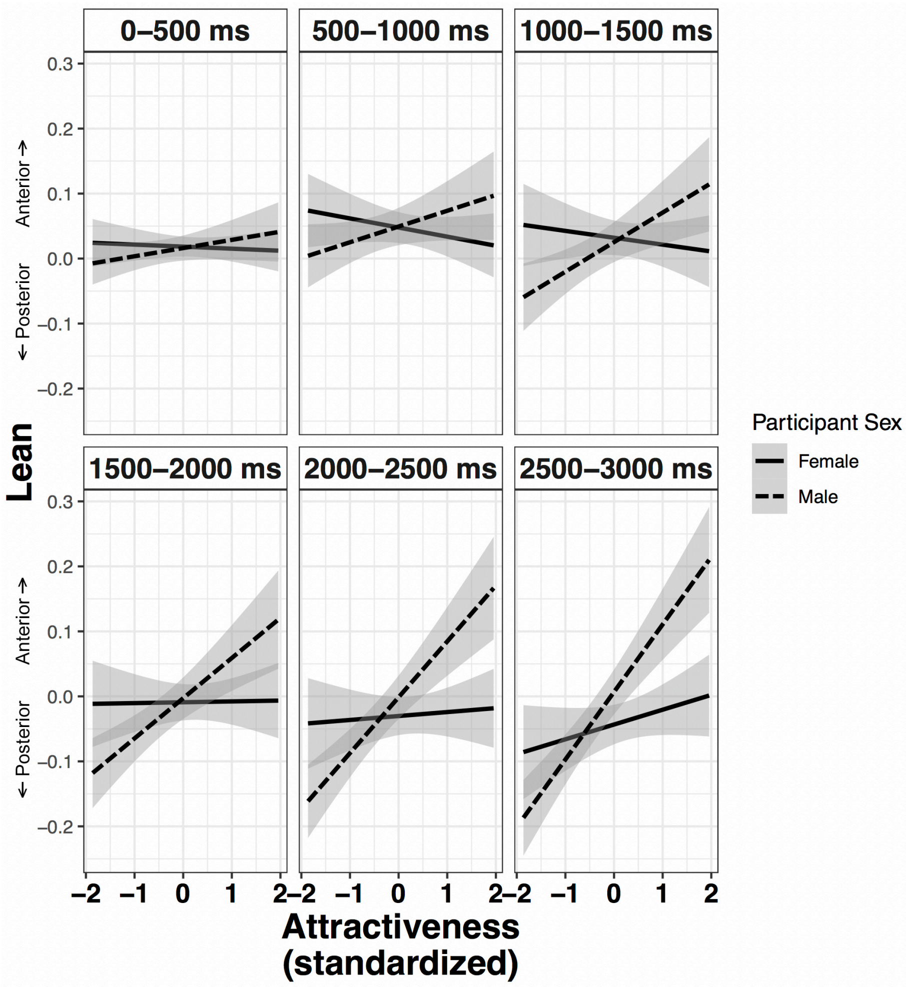

Fig. 5. An illustration of lean as a function of face Attractiveness, Participant Sex, and Time. For later time bins, participants increasingly lean towards the more attractive images, and this is more evident for men. Shaded regions represent the 95% confidence intervals.

These findings demonstrate that, in the absence of any task demands, facial attractiveness can activate approach-avoidance behavioural tendencies, as measured by postural lean. Specifically, viewers leaned towards more attractive faces and away from less attractive faces, with this pattern developing over the 3 s presentation window. The activation of approach-avoidance responses in the absence of any task demand suggests these motor activations result from a spontaneous stimulus evaluation, which is then expressed within seconds as overt changes in body lean.

6. General Discussion

Attractive faces attracted responses. Experiments 1 and 2 demonstrated approach activation even when there was no explicit instruction to evaluate facial attractiveness, and in fact, Experiment 4 found approach biases when there was no instruction to make responses of any kind. Experiment 3 further demonstrated that our effects must be generated at least in part by configural factors relating to facial attractiveness, and not merely global image characteristics like brightness.

Our results have important implications at several levels of behavioural organisation. Perhaps most importantly, they show that perceptions of attractiveness are not insulated from the motor system, despite potential costs for failures to regulate social action. Furthermore, we found some evidence not only for goal-directed approach responses (the Increase response outcome in Experiments 1 and 2), but also a tendency for relatively direct, context-insensitive approach (selection for attractive faces even with outcomes producing some avoidance). This direct effect is consistent with a bias for attention towards attractive faces (e.g., Faust et al., 2019; Sui & Liu, 2009) but the goal-oriented effects are not explained by competition for attention (for example, unattractive faces are more likely the target for response when the effect is to push away unattractive and approach attractive faces). In Experiment 4, only a single face was presented on the screen, and so again, the approach-avoidance effects here cannot reflect competition for attention but rather, specific motor engagement to approach or avoid. The ubiquitous evidence of approach responses, despite the lack of explicit instruction for affective evaluation, is striking and contrasts with previous studies of approach-avoidance (Phaf et al., 2004). As discussed earlier, there is little evidence of approach-avoidance in the absence of explicit evaluative instructions (e.g., Lavender & Hommel, 2007). If attractiveness behaved like facial expression, we might have expected effect sizes approaching zero with our methods, yet we found conventionally large effect sizes (Cohen's $d > 1.0$ and as high as 3.0), reflecting robust activation of approach-avoidance motor systems.

The tendency for relatively direct, context-insensitive approach also contrasts with the important point raised by Phaf et al. (2014) in discussing how the approach-avoidance literature can be largely understood as indirect effects of stimulus evaluation, which are sensitive to response outcomes and situational factors. As interpreted by Phaf et al., this sensitivity to response outcomes allows activated responses to be contextually appropriate. It is therefore interesting to consider the possible lack of, or at least limited, context sensitivity found with approach responses to attractiveness. The kinds of direct associations we observed between facial attractiveness and motor activations could suggest an increased risk of socially inappropriate responses. To the extent that inappropriate approach responses do not occur, they highlight the importance of systems for behaviour regulation in social contexts.

Our experiments used only women's faces. This decision was motivated by conclusions from the literature that attractiveness in women's faces is agreed by both men and women (Cunningham, 1986; Jones & Hill, 1993), cross-culturally (Cunningham, Roberts, Barbee, Druen, & Wu, 1995), and even between adults and newborns (Slater et al., 1998). In contrast, attractiveness in men's faces is more complex and more variable (Little & Hancock, 2002; Penton-Voak et al., 1999; Perrett et al., 1998; Rennels, Bronstad, & Langlois, 2008). From a scientific perspective, women's facial attractiveness will be a better starting point for new directions such as ours. In fact, the asymmetry of knowledge has recently become even more pronounced as large-scale studies have recently overturned conventional wisdom on the effects of women's hormonal states on their preferences for men's attractiveness (Jones et al, 2018; and related, Marcinkowska, Hahn, Little, DeBruine, & Jones, 2019). However, the field as a whole is at risk of a self-perpetuating cycle, where if we continue to only study women's faces then the asymmetry of our understanding for men's and women's faces will only increase. It would therefore be interesting to assess whether direct, context-insensitive approach responses are observed for attractiveness with men's faces.

It may be morally questionable, but it is still true that evaluations of facial attractiveness are fundamental to human social decision-making. Our findings demonstrate, for the first time, that perceptions of facial attractiveness have spontaneous influence all the way into the motor system, to activate task-irrelevant approach and avoidance responses.

Supplementary material

The data are available on the Open Science Framework: http://doi.org/10.17605/OSF.IO/5ZUJ4.

Declaration of Competing Interest

None.

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